Claims

1. Apparatus for generating a mist comprising:

a conduit having a mixing chamber and an exit;

a working fluid inlet in fluid communication with said conduit, the working fluid inlet adapted to introduce a working fluid into the conduit; and

a transport nozzle in fluid communication with the said conduit, the transport nozzle adapted to introduce a transport fluid into the mixing chamber;

characterised in that the transport nozzle includes a convergent-divergent portion therein such as in use to provide for the generation of high velocity flow of the transport fluid;

and wherein the transport nozzle and conduit have a relative angular orientation such that in use the working fluid is atomised and a dispersed droplet flow regime of droplets is created in the mixing chamber by the introduction of transport fluid flow from the transport nozzle into working fluid flow from the conduit and the subsequent shearing of the working fluid by the transport fluid, wherein the angular orientation of the transport nozzle and conduit is such that the shearing of the working fluid creates a dispersed droplet flow regime in which a substantial portion of the droplets have a size of less than 20μm.

2. The apparatus of claim 1, wherein the working fluid droplets have a substantially uniform droplet distribution having droplets with a size less than 20μm.

3. The apparatus of claim 1 or 2, wherein the substantial portion of the droplets has a cumulative distribution greater than 90%.

4. The apparatus of any preceding claim, wherein a substantial portion of the droplets have a droplet size less than 10μm

5. The apparatus of any preceding claim, wherein the transport nozzle substantially circumscribes the conduit.

6. The apparatus of any preceding claim, wherein the mixing chamber includes a converging portion.

7. The apparatus of any of claims 1 to 5, wherein the mixing chamber includes a diverging portion.

8. The apparatus of any preceding claim, wherein the internal geometry of the transport nozzle has an area ratio, namely exit area to throat area, in the range 1.75 to 15, having an included α-angle substantially equal to or less than 6 degrees for supersonic flow, and substantially equal to or less than 12 degrees for sub-sonic flow.

9. The apparatus of any preceding claim, wherein the transport nozzle is oriented at an angle β of between 0 to 30 degrees.

10. The apparatus of any preceding claim, wherein the transport nozzle is shaped such that transport fluid introduced into the mixing chamber through the transport nozzle has a divergent or convergent flow pattern.

11. The apparatus of claim 10, wherein the transport nozzle has inner and outer surfaces each being substantially frustoconical in shape.

12. The apparatus of any preceding claim, further including a working nozzle in fluid communication with the conduit for the introduction of working fluid into the mixing chamber.

13. The apparatus of claim 12, wherein the working nozzle is positioned nearer to the exit than the transport nozzle.

14. The apparatus of claim 12 or 13 , wherein the working nozzle is shaped such that working fluid introduced into the mixing chamber through the working nozzle has a convergent or divergent flow pattern.

15. The apparatus of any of claims 12 to 14, wherein the working nozzle has inner and outer surfaces each being substantially frustoconical in shape.

16. The apparatus of any preceding claim, further including a second transport nozzle being adapted to

introduce further transport fluid or a second transport fluid into the mixing chamber.

17. The apparatus of claim 16, wherein the second transport nozzle is positioned nearer to the exit than the transport nozzle.

18. The apparatus of claim 17, wherein the second transport nozzle is positioned nearer to the exit than the working nozzle, such that the working nozzle is located intermediate the two transport nozzles.

19. The apparatus of any preceding claim, wherein the conduit includes a passage.

20. The apparatus of claim 19, wherein the inner wall of the passage is adapted with a contoured portion to induce turbulence of the working fluid upstream of the transport nozzle.

21. The apparatus of any preceding claim, wherein the mixing chamber includes an inlet for the introduction of an inlet fluid.

22. The apparatus of any preceding claim, wherein the mixing chamber is closed upstream of the transport nozzle.

23. The apparatus of any preceding claim, further including a supplementary nozzle arranged inside the transport nozzle and adapted to introduce further

transport fluid or a second transport fluid into the mixing chamber.

24. The apparatus of claim 23, wherein the supplementary nozzle is arranged axially in the mixing chamber.

25. The apparatus of claim 23 or 24, wherein the supplementary nozzle extends forward of the transport nozzle.

26. The apparatus of any of claims 23 to 25, wherein the supplementary nozzle is shaped with a convergent-divergent profile to provide supersonic flow of the transport fluid which flows therethrough.

27. The apparatus of any preceding claim, further including control means adapted to control one or more of droplet size, droplet distribution, spray cone angle and projection distance.

28. The apparatus of any preceding claim, further including control means to control one or more of the flow rate, pressure, velocity, quality, and temperature of the inlet and/or working and/or transport fluids.

29. The apparatus of claim 27 or 28, wherein the control means includes means to control the angular orientation and internal geometry of the working and/or transport and/or secondary nozzles.

30. The apparatus of any of claims 27 to 29, wherein the control means includes means to control the internal geometry of at least part of the mixing chamber or exit to vary it between convergent and divergent.

31. The apparatus of any preceding claim, wherein the exit of the apparatus is provided with a cowl to control the mist.

32. The apparatus of claim 31, wherein the cowl comprises a plurality of separate sections arranged radially, each section adapted to control and re-direct a portion of the discharge of mist emerging from the exit.

33. The apparatus of any preceding claim, wherein the apparatus for generating a mist is located within a further cowl.

34. The apparatus of any preceding claim, wherein at least one of the transport, secondary or working nozzles is adapted with a turbulator to enhance turbulence.

35. A spray system comprising apparatus of any of claims 1 to 34 and transport fluid in the form of steam.

36. The spray system of claim 35, further including working fluid in the form of water.

37. The spray system of claim 35 or 36, further including a steam generator and water supply.

38. The spray system of claim 37, wherein the spray system is portable.

39. A method of generating a mist comprising the steps of:

introducing a flow of transport fluid into a mixing chamber through a transport nozzle;

introducing a working fluid into the mixing chamber through a conduit;

generating a high velocity flow of the transport fluid by way of a convergent-divergent portion within the transport nozzle;

orienting the transport nozzle and conduit such that the high velocity transport fluid flow imparts a shearing force on the working fluid flow; and

atomising the working fluid and creating a dispersed droplet flow regime of droplets under the shearing action of the working fluid on the transport fluid, wherein the shearing action creates a dispersed droplet flow regime in which a substantial portion of the droplets have a size less than 20μm.

40. The method of claim 39, wherein the apparatus is an apparatus according to any of claims 1 to 38.

41. The method of claim 39 or 40, wherein the stream of transport fluid introduced into the mixing chamber is annular.

42. The method of any of claims 39 to 41, wherein the working fluid is introduced into the mixing chamber via an inlet of the mixing chamber of the apparatus.

43. The method of any of claims 39 to 41, wherein the working fluid is introduced into the mixing chamber via a working nozzle in fluid communication with the conduit of the apparatus.

44. The method of claim 43, wherein an inlet fluid is introduced into the mixing chamber via an inlet of the mixing chamber of the apparatus.

45. The method of any of claims 39 to 44, wherein the method includes the step of introducing the transport fluid into the mixing chamber in a continuous or discontinuous or intermittent or pulsed manner.

46. The method of any of claims 39 to 45, wherein the method includes the step of introducing the transport fluid into the mixing chamber as a supersonic flow.

47. The method of any of claims 39 to 46, wherein the method includes the step of introducing the

transport fluid into the mixing chamber as a sub-sonic flow.

48. The method of any of claims 39 to 47, wherein the method includes the step of introducing the working fluid into the mixing chamber in a continuous or discontinuous or intermittent or pulsed manner.

49. The method of any of claims 39 to 48, wherein the mist is controlled by modulating at least one of the following parameters:

the flow rate, pressure, velocity, quality and/or temperature of the transport fluid;

the flow rate, pressure, velocity, quality and/or temperature of the working fluid;

the flow rate, pressure, velocity, quality and/or temperature of the inlet fluid;

the angular orientation of the transport and/or working and/or secondary nozzle(s) of the apparatus;

the internal geometry of the transport and/or working and/or secondary nozzle(s) of the apparatus; and

the internal geometry, length and/or cross section of the mixing chamber.

50. The method of claim 49, wherein the mist is controlled to have a substantial proportion of its droplets having a size less than 20μm.

51. The method of claim 49, wherein the mist is controlled to have a substantial proportion of its droplets having a size less than 10μm.

52. The method of any of claims 39 to 51, including the generation of condensation shocks and/or momentum transfer to provide suction within the apparatus.

53. The method of any of claims 39 to 52, including inducing turbulence of the inlet fluid prior to it being introduced into the mixing chamber.

54. The method of any of claims 39 to 53, including inducing turbulence of the working fluid prior to it being introduced into the mixing chamber.

55. The method of any of claims 39 to 54, including inducing turbulence of the transport fluid prior to it being introduced into the mixing chamber.

56. The method of any of claims 39 to 55, wherein the transport fluid is steam or an air/steam mixture.

57. The method of any of claims 39 to 56, wherein the working fluid is water or a water-based liquid.

58. The method of any of claims 39 to 57, wherein the mist is used for fire suppression.

59. The method of any of claims 39 to 58, wherein the mist is used for decontamination.

60. The method of any of claims 36 to 59, wherein the mist is used for gas scrubbing.